

**ALIMENTARY HYPERSECRETION; GASTRIC HYPERSECRETION;
GASTROCHRONORRHEA.**

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We are in the midst of a period in clinical gastric research wherein the attention of the majority of workers is focussed on diseases characterized by organic or structural changes in the tissue wall of the stomach or duodenum. Ulcer and cancer are the all-absorbing topics of discussion, and not without good reason. The advent of the roentgen ray, with its marvellous ability to portray defects and distortions of the borders of the organ, has given a strong impulse to the study of structural diseases. In so doing the observations of functional disturbances have fallen into the background and a lesser interest and eagerness have been shown in attempting to reclassify and evaluate the various forms of secretory disturbances to which the stomach, as a major secreting organ, is subject.

The total daily gastric secretion is no inconsiderable factor in the human physiology. It is estimated in amount as normally up to 1000 c.c., being thus second only to that of the kidney, though in composition its excretion is much more simple and chemically less complex. The older methods for the study of this secretion lay entirely in the use of the single test-meal, be it Bwald, Riegel, Sahli or other. Such a method was inadequate and unsatisfactory and contributed much to the lack of interest in the functional gastric diseases.

The introduction of a newer and improved method for withdrawing specimens of stomach secretion, the fractional test-meal, has given us an opportunity to look back over some of the older though still mooted questions in gastro-enterology in the hope that the application of such a method would throw a new and elucidating light on disputed points still far from settlement.

The topic of hypersecretion is just such a one. It has remained to date still a point in debate as to whether gastric hypersecretion was a normal phenomenon or whether it was a purely nervous phenomenon or whether after all hypersecretion was a manifestation of ulcer. Boas,¹ as recently as 1911, says that the significance of this phenomenon remains with future students to interpret, and though frequently expressing his personal

opinion in a discussion of the facts, always guards himself against some future reversal of his stand on any point.

Since Reichmann,² a practising physician in Warsaw in 1882, first described a case which he called "Magensaftfluss," up to quite recently, a prodigious amount of energy and effort has been spent in attempting to elucidate the clinical and chemical picture which he presented. Reichmann described a single case characterized by the presence in the fasting stomach of a large amount (100 to 1000 c.c.) of a fluid, bearing all the properties of pure gastric secretion. Clinically the patient suffered from progressive emaciation, headaches, vomiting, pyrosis, eructations and postprandial pains, particularly severe at night. Reichmann regarded his case as a functional secretory overactivity of the gastric glands; six hours after a full meal he was able to remove by lavage two and a half liters of gastric contents, containing food, sarcinæ, yeast and much hydrochloric acid. He does not suggest the possibility of ulcer nor does he mention ulcer as a possible factor underlying the complaint.

His publication aroused much discussion and brought out many publications, among the most important of which were those of Jaworski and Glucinski,³ Riegel,⁴ Schreiber,⁵ Rössbach,⁶ Jurgensen⁷ and others. The discussion hinged mainly on the point whether Reichmann had described a rare and very unusual condition or whether hypersecretion was not, at least in its milder grades, a rather common clinical phenomenon. The dispute centered mainly upon the amount of fasting contents that could be called normal. Rosin,⁸ Riegel,⁹ Martius¹⁰ and Strauss¹¹ found in the normal fasting contents not over 12 to 20 c.c. of fluid. Boas,¹² Huber¹³ and particularly Schreiber⁵ found normally up to 50 and 100 c.c. These authors, being unable to agree upon an accepted maximum figure for the amount of fasting contents, were unable to agree as to what to call hypersecretion and what to call normal. Riegel,⁹ who believed that the normal fasting stomach should be nearly empty, found many cases which he regarded as mild hypersecretion, while Schreiber,⁵ whose normal standard was much higher, regarded real hypersecretion as excessively rare. Jaworski¹⁴ found the condition present in 115 of 159 cases examined. In 1887 Reichmann¹⁵ contributed a more complete study of the syndrome he had originated. He described many cases in which the phenomenon occurred periodically, attributing the findings to various conditions of nervous irritability such as tabetic crises, hysteric crises, etc., but was able to collect in these five years only six real cases wherein pure continuous hypersecretion occurred, independently, in his opinion, of any organic lesion.

From this time to the present the discussion continues as to the occurrence of the disease as a clinical entity and as to the interpretation of continuous hypersecretion when it does occur. In general it may be said that differ as they might on the incidence of the

disease, nearly all agreed that hypersecretion was a symptom of functional overstimulation of the gastric glands through excessive nervous excitation.

The advent of the period of gastric surgery introduced an entirely new and very valuable factor. The increasing recognition of gastric and duodenal ulcer as an etiologic factor in abdominal disorders caused a reclassification of diseases of the stomach. One notes, particularly in this field, the swing of the pendulum in favor of organic explanations. Soupault¹⁶ operated upon 58 cases of so-called gastrosuccorhea and reported finding ulcer in all. Hayem¹⁷ and Mathien,¹⁸ leaders of the French school of gastro-enterologists, accepted this view with few reservations. Boas¹ in the 1907 edition of his book was undecided, but in the 1911 edition he attributes at least two-thirds of the cases to gastric or duodenal ulcer though admitting the existence of some of the cases upon a purely neurotic basis. Ewald,¹⁹ however, still clung to his opinion of a real neurosis as the basis of the phenomenon.

Interest in the subject of the milder forms of hypersecretion as one phase of the gastric physiology of digestion was actively renewed when Strauss,¹¹ in 1903, pointed out the very common occurrence of hypersecretion in numerous gastric disorders. Strauss, and those that took sides in the discussion which he aroused (Zweig, Calvo, Huppert, Grandauer), laid little emphasis on the amount of fasting contents. They described "alimentary" hypersecretion, that is, an excessive digestive secretion occurring during and after the period of active digestion. To them "Reichmann's disease," or continuous hypersecretion, was a rare and much exaggerated form of alimentary hypersecretion. In its milder form it occurred in 31 per cent. of all male cases, and 8 per cent. of all the female cases examined. These authors were divided as to its interpretation; the weight of opinion, however, favored hypersecretion as being a state of increased secretory stimulation, in the largest percentage due to ulcer or other intrinsic gastric causes.

This rather prolonged review of the literature should be pardoned by the reader. There is so much of confusion associated with the phrase "gastric hypersecretion" that it has been deemed not superfluous to collect the opinions of those who have previously been interested in this topic. Summarizing these efforts, one distinguishes the following:

A. *Continuous Hypersecretion* (Magensaftfluss or Reichmann's disease), a malady having a characteristic clinical picture and evidenced by continuous outflow of large quantities of secretion both in the digestive and interdigestive and fasting states. Surgery has pretty nearly classified most of these as cases of pyloric stenosis due to ulcer; the medical men succeeded in establishing a smaller number on the basis of pure neurosis.

B. *Continuous Hypersecretion*, occurring not chronically but in intermittent form, associated with periodic migraine, tabetic crises,

paroxysmal hysterical vomiting spells, etc. These are accepted by all as cases due to excessive stimulation of the gastric nerves of central nervous system origin.

C. *Alimentary Hypersecretion*, not really a disease but a symptom or chemical phenomenon occurring during digestion. This milder form of secretory stimulation was shown to be a very common phenomenon and generally attributed to protopathic organic origin, usually ulcer.

The fractional test-meal as a means of studying gastric physiology and chemistry, having introduced a new and undoubtedly valuable clinical method, it has been deemed warrantable to reopen this subject for investigation. The Ewald test-meal furnished information of the activity of the stomach at its supposed height or one hour after the ingestion of a simple meal, but it can readily be shown that hypersecretion when it does occur, takes place almost entirely after the fastigium is reached or in the declining stage of motor activity. The very definition of *magensaftfluss* or *gastrochronorrhoea* (Hayem) is secretion activity after the digestive cycle and in the interdigestive cycle. Hence the fractional method has furnished an ideal means for studying the digestive, postdigestive and interdigestive states. In so doing it has established an entirely new criterion upon which to base the judgment of what is or what is not a normal amount of gastric secretion, and what is the clinical significance of an outflow of digestive juices when it occurs to an abnormal degree. In fact, Hayem²⁰ who years ago used repeated test-meals, extracting them on successive days, one-half, one, one and a half, and two hours after ingestion, introduced the term *gastrochronorrhoea* as an improvement on the term *gastrosuccorrhoea* to indicate an abnormal secretion in the post and interdigestive periods. When discussing this disease his attention was entirely focussed on this phase of the subject.

In the fractional test-meal as at present employed, with the indwelling tube of Rehfuess, and using oatmeal gruel as a test substance, it is simple to determine the amount of secretion poured out by the secretory acini in proportion to the residue of gruel in the stomach at any given period.

The fasting stomach contents being first removed and the gruel meal being drunk, successive fifteen-minute specimens are withdrawn until no further material can be aspirated. The first quarter of an hour specimen is normally nearly all gruel, or at least four-fifths gruel and one-fifth secretion. At the end of the half-hour there is still at least two-thirds gruel and one-third secretion present. By the end of the first hour the stomach has produced about as much secretion as there is gruel in the viscous, always remembering, of course, the fact that gruel is constantly passing out of the stomach through the pylorus. In the successive periods the secretion becomes relatively more abundant and the gruel less in amount, until by the sixth or seventh quarter-hourly specimen there is only one-sixth to

one-eighth of gruel present in the test-tube, upon settling, all the remainder being secretion produced by the glands. At the end of one and three-quarters to two hours the stomach has expelled the last trace of gruel (iodin-starch test negative). Normally the glandular secretion ceases after this period and further attempts to aspirate either meet with no success or bring up only two or three c.c. of mixed gastric mucus and saliva. The stomach as a secretory digesting organ has come to rest. If the secretion of the stomach, now more properly called parasecretion (Boas), continues we have the phenomenon of hypersecretion or supersecretion. This hypersecretion may be present during the latter stage of the normal digestion, as evidenced by the greater proportion of secretion to gruel in the withdrawn specimens; and it may and usually does last for one-half to one hour after the organ has completely evacuated the food. This we recognize as alimentary hypersecretion. If the parasecretion is present during the second, third and fourth and later hours of the postdigestive cycle we recognize a continuous hypersecretion, or gastrochronorrhœa.*

The following original studies have been made upon 50 cases in which sixty-eight fractional tests have been made. The cases were collected in the medical wards of Mount Sinai Hospital, a smaller percentage being added, from the private practice of the writers. Clinical observations were maintained for a period in each case of several weeks; in many of the cases the observations extend over months and in some years. Careful clinical and chemical studies, exact roentgenologic observations, and in many cases findings at the operating table tend to form as complete a collection of data as is possible, upon which to base a diagnosis of the underlying condition. Cases in which a definite and marked delay in motility was present have been excluded particularly if food residue or sarcinæ and lactic acid were present in the fasting contents, as these cases were evidently examples of pyloric stenosis of organic origin and not simple hypersecretion. In these cases there being practically no interdigestive state but just one continuous stage of digestive activity, we are unable to judge of the condition of the organ in the usual resting period.

Incidence. It is impossible to judge of the frequency of the occurrence of hypersecretion in the hospital, as no statistics have been kept of the total number of fractional test-meals taken. At Mount Sinai Hospital the fractional test is employed almost as a routine test; the number of observations is therefore very large. An idea of the incidence of hypersecretion is more easily judged from the cases seen in private practice. Of the last 100 fractional tests taken in the office by the authors twenty showed definite hypersecretion (20 per cent.). This figure is lower than that of Jaworski,¹⁴ who found 115 instances in an examination of

* Strauss,¹¹ using a test-meal of dry crackers, recognizes a percentage of dry residue to secretion greater than 1 to 4 or 5 as a case of hypersecretion.

159 patients. (As was previously noted, Jaworski judged almost entirely on fasting content findings.)

As a symptom, hypersecretion is anything but rare. When Reichelmann² first described the syndrome it was regarded as unusually uncommon. The later writers, as well as these figures, prove it to occur in at least 1 out of every 3 cases examined.

Sex. The male sex predominates greatly, 88 per cent. of the cases being in males. This agrees with the data of the older investigators.

Age Incidence. There are no observations below the ages of twenty and none over seventy years. Approximately 55 per cent. of the cases occurred between thirty and fifty years of age, 16 per cent. between twenty and thirty years.

Seasonal variations are not noticeable.

Laboratory Data. In cases of hypersecretion the fasting contents of the stomach is increased. It is useless to enter into a discussion as to the maximum amount of secretion found in this viscous in the morning before the first meal has been taken (*liquid à jeun*). Estimates of various authors show a wide range, most of them lying between 10 and 20 or 30 c.c. However, many other writers include any amount up to 50 to 100 c.c. as normal. These latter figures are too high in our experience. The fasting content in many hundreds of cases is normally rarely more than 30 c.c.; larger amounts indicate abnormal secretory activity or delayed motility, or both. In this series of 50 cases of hypersecretion the resting stomach in the morning contained on an average 65 c.c. The actual figures lie between 0, found only once in a case of achylia with hypersecretion, and 180 c.c. in a case of ulcer with normal range of acidity but marked hypersecretion. Findings of 90, 120, 130 c.c. or more are common. The fluid withdrawn is always clear, watery, slightly milky or cloudy and shows a faint admixture of bile and salivary secretion. Food residue is never present in cases of pure hypersecretion without organic pyloric stenosis. The fluid found is practically a pure secretion of the gastric tubules. We have been fortunate enough to observe 2 cases in which we could prove an active secretion in the fasting case. In 1 of these cases 130 c.c. of pure watery secretion was removed. After five minutes another 30 c.c. of clear aqueous liquid was extracted, and thereafter every five minutes 30 c.c. of the same liquid clear material was aspirated. This was observed for a half hour, whereupon our observations ceased, though the fluid was still being produced. The material withdrawn was free of biliary and pancreatic regurgitation, as evidenced by its color and freedom from pancreatic ferments, and free of saliva, the patient being watched and instructed to expectorate all fluids accumulating in the mouth. In this case at least a definite rate of flow was observed; 30 c.c. every five minutes, or 360 c.c. an hour. If continued for twenty-four hours in the fasting state this

would have meant 7344 c.c. per day. During the digestive periods this rate of flow would probably have been much accelerated.

We have attempted to collect fasting secretion in many patients not suffering from hypersecretion, by similarly emptying the residue and then watching every five minutes for evidence of normal secretory activity, but could never collect more than 1 or 2 c.c. of viscid material in such an interval.

The acidity of the fasting contents in hypersecretion shows the same range as normal cases, free acid ranging from 0 to 94 per cent., average 30 per cent.; total acidity from 10 to 100 per cent., averaging 52 per cent. The acid titer of the fasting stomach is usually lower than the acidity at the height of digestive activity, but is usually of the same titer as is the fluid produced in the postdigestive hypersecretory phase. The titer of the fasting contents is the titer of the gastric secretion of that individual stomach for the whole of the twenty-four hours except for the short periods in which digestive activity is at its maximum.

Ewald Test-meal. The most important factor to be determined is the total amount withdrawn. This varied between 10 c.c. (achylia gastrica) and 325 c.c. as a maximum. The average amount was 102 c.c., a figure decidedly above the normal. The proportion of fluid to solid food residue (starch) was always from 4 to 1 to 10 to 1, indicating a large increase in the secretory quotient. The acidities were for free acid an average of 35 per cent., for the total acid 64.3 per cent.

Fractional Test-meals. It is with the fractional test that the greatest information is derived. The curves were observed (quarter-hourly) for from two to six hours, after the ingestion of the meal. As the emptying time was not materially different from the normal standard, practically every period after two hours (or two and a quarter hours) represents a pure hypersecretory phase. The duration of the observations in most of the cases was limited only by the time at the convenience of the observer and the fortitude and indulgence of the patient. Most of the cases observed four, five and six hours were secreting just as strongly then as at the beginning and gave every indication of being cases of continuous hypersecretion. On the other hand, after the two- or three-hour period some of the cases seemed to wane, and some to come to an end, with a gradual fall of the acidity curve. These were examples of alimentary hypersecretion. Between 50 per cent. and 60 per cent. of the cases gave every indication of being of the continuous type. This is a rather striking figure in contrast with the idea of Reichmann, Riegel and others, who regarded continuous hypersecretion as a very rare phenomenon. It is probable that some or many of the cases regarded here as alimentary would also have fallen into the class of continuous secretion had they been observed for a longer period.

The maximum height of free acid in this series of fractional tests

ranged from 0 to 114 per cent., but averaged 69.2 per cent. The maximum titer for total acidity varied from 14 per cent. or 20 per cent. in very few cases, to 140 per cent. in extreme types. The average for all cases was 84 per cent., but the number of cases titrating between 100 and 136 was 16 out of a total of 68 curves studied. From these figures we readily surmise that hyperacidity and hypersecretion are close concomitants, though not necessarily so. The type of the curve is of more interest than the height or altitude of acidity reached. The curve in most cases shows two phases: a primary or digestive phase, following rather closely the usual digestive curves and showing a tendency to return toward the base line at the end of two hours (emptying time); and a secondary curve, characterized by a slight secondary rise until a certain level is reached. This level is maintained with very little variation for hours and hours. The level sought by any individual is personal to that individual; some stand steady at 40 per cent. for total acidity, some at 50 per cent. or 60 per cent. and a few still higher. Such an illustration is seen in Chart I, representing a case of pyloric ulcer with a mild grade of pyloric stenosis present. The secondary phase is established at 50 per cent. acidity.

Pathologic physiology has emphasized the supreme importance of motility and emptying time in the stomach.

In cases of pure hypersecretion without evident organic disease there is no change from the normal standard of motility. Occasional exceptions will be noted later. The presence of a pyloric or peripyloric ulcer introduces another and a mechanical factor, often coexistent with the hypersecretion. In the presence of organic disease, delay in motility can safely be attributed to the pathologic process. In a large number of this series where no organic disease was suspected a normal emptying time existed in the presence of marked hypersecretion.

The Clinical Diagnosis in Cases of Hypersecretion. The cases in this series were grouped under the following diagnoses.*

TABLE I.

Duodenal } ulcer	13
Gastric }	
Carcinoma of stomach	3
Carcinoma of common bile duct	1
Cholelithiasis	2
Gastric neurosis	19
Syphilis, tertiary	3
Syphilis, tabetic crises	1
Migraine, neurosis	2
Spastic colitis, neurosis	2
Asthma	1
Achylia gastrica	1
Chronic appendicitis	5
Tuberculosis of kidney	1

* In four of these cases a diagnosis of concurrent duodenal ulcer and chronic appendicitis is made.

hours after the ingestion of the oatmeal gruel. We observe here a prolonged and sustained digestive cycle with a maximum acidity between 70 per cent. and 80 per cent. and a secondary stage of supersecretion lasting indefinitely thereafter, though maintained at a constant though lower level of acidity. This case may well have been accounted as one of Reihmann's disease, for it bears all the clinical characteristics of such, as, for instance, abdominal pain, acid eructations, vomiting of very large amounts of fluid, loss of weight, excess of material in fasting contents and continuous secretion of the stomach at all times throughout the day.

Yet it was a case proved at operation to be one of peripyloric ulceration.

Chart II is an illustration of an instance of exaggerated hypersecretion, accompanying most likely a gastric or duodenal ulcer.

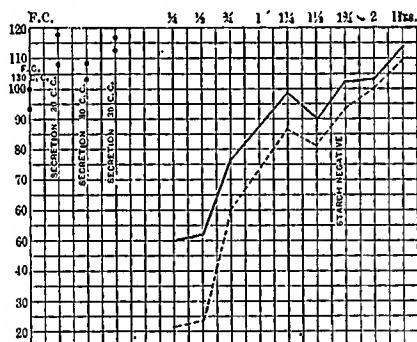


CHART II

During the last two years the patient had suffered with recurrent attacks of belching, heartburn eructations and constipation. The attacks were separated by intervals of three to five months of well-being. During the attacks copious vomiting took place, usually a few hours after eating, the vomitus being occasionally brownish-black in color. Stools were dark brown, but never absolutely black. On one occasion we were able to wash from this man's stomach skins of prunes eaten thirty hours previously.

The fractional chart shows that 130 c.c. fasting contents containing food were obtained. Thereafter (still in the fasting state) every five minutes 30 c.c. were removed, consisting of clear watery fluid and representing pure continued secretion in the fasting state. The gruel test-meal followed and demonstrated a condition of marked hypersecretion. The last gruel left the stomach at the

one and three-quarter hour period; following this we note another period of continuous gastrosuccorrrhea, the observations being interrupted by the fatigue of the patient. The level attained by the gastric supersecretion was unusually high, reaching between 120 per cent. and 130 per cent. at the last observation.

We note that the level of acidity in this case in the empty or supposedly resting state is far different from that in the preceding one (Chart I), the resting level here being about 120 per cent. while in the previous one it is 40 to 50 per cent. We have observed many cases of ulcer in which the level of the supersecretion lay between these two extremes. The height or average altitude of acidity is no index of the disease and no level can be said to be characteristic of ulcer. Every person may be said to have his or her average level, common to that person both in health and disease.

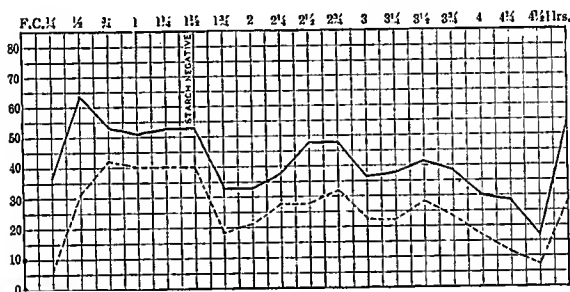


CHART III

The following case was one of a neurotic nature, with some evidence of mild disease process in distal organs. He suffered from an inactive pulmonary tuberculosis; he had complained for eight years of vague generalized abdominal pains and occasional attacks of diarrhea. He was of a neurotic temperament, easily frightened and irascible. A simple chronic granular proctitis and sigmoiditis was present. His gastro-intestinal roentgen-ray examination was negative. The chart (Chart III) of this case was typical of a continuous hypersecretion with low, titrable acidity; the primary digestive phase lasted only one and a half hours and was followed by a typical secondary continuous supersecretion lasting up to four and three-quarter hours, the observation being interrupted because of the fatigue of the patient at this point.

Chart IV illustrates the fractional curve in the case of an adult male suffering for four weeks from nervousness, sleeplessness, heavy

sensation in abdomen, loss of appetite and constipation. This was evidently an example of psychoneurosis with some abdominal symptoms. The chart was one of typical hypersecretion, there being a constant outpouring of abundant clear fluid in all the fractional tubes examined. Motility was normal.

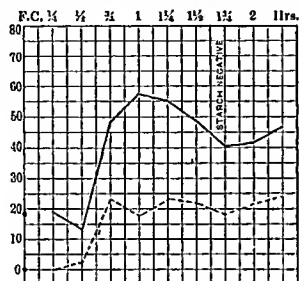


CHART IV

The hypersecretion present here was probably part of a general neurosis; hyperstimulation of the vegetative nervous system was manifested in many of his clinical symptoms.

The next case (Chart V) was that of a man, aged sixty-seven years, who had been under observation in the hospital on and off during

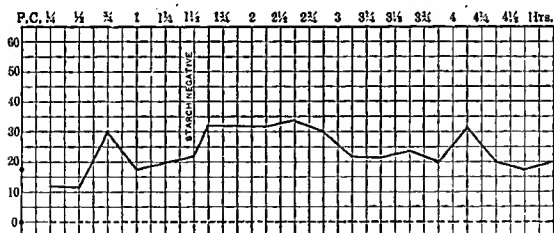


CHART V

the last five years, suffering from constant pain in the epigastrium referred to the precordium, worse in the fasting state. Generalized pruritus was present, as well as chronic constipation.

Chart V showed a condition of anacidity accompanied by a marked hypersecretion. The emptying time was one and a half

hours, yet when observed up to the four and three-quarter hour period this stomach was freely secreting a limpid fluid containing no free acid and a total acidity about 20 per cent. Only a few cubic centimeters of fasting contents could be obtained in the morning. There was present in this man a functional disturbance of the gastric secretion probably of a neurogenic origin.

Chart VI represents a similar case in a middle-aged female, with exaggerated subjective gastric symptoms. Thorough observation over several weeks failed to reveal the presence of organic disease. The fractional curve was one of complete anacidity (ferments faintly present) with a prolonged hypersecretion.

It is impossible to differentiate in such a curve the hypersecretory from the digestive phase.

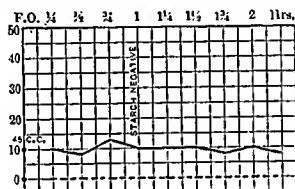


CHART VI

Cases 2 to 6 inclusive are examples of gastric neurosis with functional hypersecretion. The emptying time was normal in all, the range of acidity from complete anacidity to hyperacidity. Hypersecretion is the one common factor being present throughout, independent of the range of the acid titer. Vomiting was not present in these cases, nor were any large amounts of fasting contents obtained on repeated examinations. They are more in the nature of alimentary hypersecretion (hyperpepsia of Hayem) though some of them partake also of the character of continuous supersecretion (gastrochronorrhea of Hayem).

The next example is illustrative of a case of late syphilis, with 4-plus positive Wassermann reaction. Organic disease of the stomach was lacking, radiograms showing only ptosis with normal gastric contour. The Wassermann reaction in the spinal fluid was similarly 4-plus, though no clinical evidence of syphilis of the nervous system was present. The fractional curve, Chart VII, was typical of that of continuous hypersecretion; emptying time normal two and a quarter hours, followed by an enduring phase of pure hypersecretion observed up to four and a quarter hours.

Syphilis was present in 4 of the 50 cases studied and was an important factor etiologically.

The following 2 cases, Charts VIII and IX, were instances of general neurosis, accompanied by chronic migraine and frequent attacks of vomiting, often of large amounts of fluid. The malady extended in both cases over a large number of years.

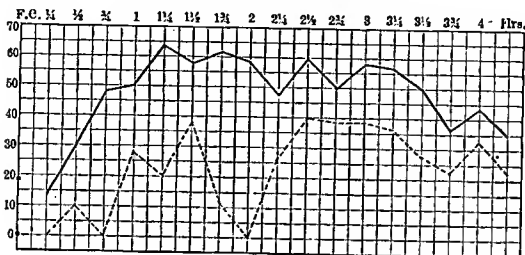


CHART VII

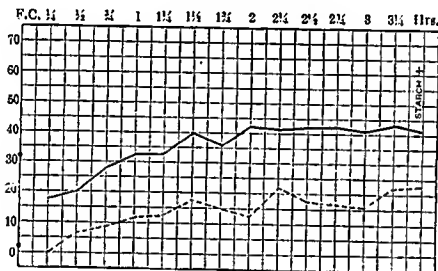


CHART VIII

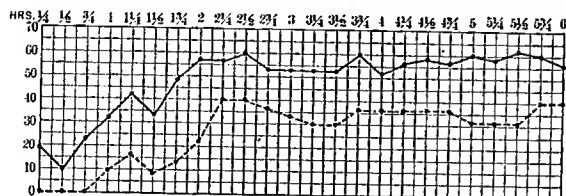


CHART IX

A definite delay in motility was observed in both cases. In Chart VIII we note that at three and a half hours starch (oatmeal)

gruel) was still present in the stomach; in Chart IX starch was visible *at the end of six hours*. In this latter case organic disease at the pylorus was so strongly suspected that operation was advised. Laparotomy revealed a patent pylorus, easily admitting two fingers and no evidence of organic malformation. In this group we have hypersecretion accompanying the symptom-complex of migraine and associated with a definite delay in gastric motility. Pylorospasm is here probably the primary gastric factor, the hypersecretion being due to the prolonged stay of the food in the viscus.

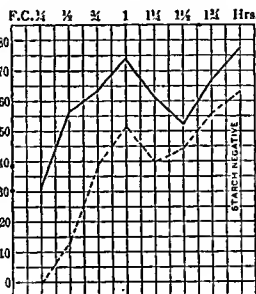


CHART X

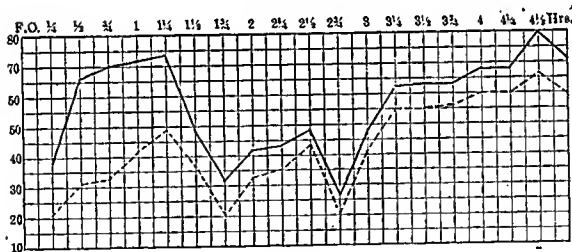


CHART XI

What relationship exists between hypersecretion and the various clinical pictures with which it is associated? A reference to Table I will show that it is associated with no single clinical complex or disease. It exists as a frequent concomitant of gastric and duodenal ulcer, more particularly of the former. As such it is often associated with delayed motility due to pylorospasm or pyloric stenosis (5 out of 13 cases), while in another larger group (7 out of 13 cases) motility was normal and yet hypersecretion present.

If to this group we add the 3 cases of carcinoma of the stomach with hypersecretion, we have 16 cases of gastrosceorrhea apparently due to protopathic or intragastric irritative stimulation. Many of these cases were rather typical of the syndrome of Reichmann's disease as he first described it in 1882. It is quite probable that in the early literature all cases of Reichmann's disease were cases of pyloric ulcer or pylorospasm from gastric or duodenal ulcer. Among these 16 cases of organic disease of the stomach is a fair number showing only limited degrees of hypersecretion (alimentary hypersecretion) and not developing at any time the *continuous* magensaftfluss and copious vomiting of the Reichmann syndrome. Further we know from our own statistics published in an earlier paper²¹ that only 30 per cent. of all gastric or duodenal ulcers show hypersecretion. Thus we may draw the conclusions that organic disease of the stomach (ulcer or neoplasm) explains only about one-third of the cases of hypersecretion.

In the next group we can place 2 cases of cholelithiasis and 3 cases of chronic appendicitis, all with reflex gastric symptoms. These form a very well-defined group. In the 3 cases of chronic appendicitis, with irritative symptoms perfect health and function was restored after the removal of the appendix. These 5 cases, together with a case of carcinoma of the common bile duct, constitute 6 cases of organic disease in neighboring organs with reflex gastric hypersecretory phenomena.

The type of curve in these cases was more in the nature of alimentary hyperpepsia than modelled after the chronic supersecretive type. This group represents extrinsic gastric stimulation of organic and abdominal origin.

The remaining cases fall into a final group. They produce their irritative hypersecretory phenomena through the nervous regulatory apparatus of this important secretory viscera. There seems little doubt that psychical influences play an important role in many of these cases. Thus in two of the cases included in this series, "bad news" initiated the subjective gastric phenomena.

In another case, one in the hospital ward being treated for asthma, an interesting observation was made. He was a young male adult suffering for many years with attacks of asthma occurring at irregular intervals. He complained, in addition (during the last four months), of severe abdominal cramp-like pains in the right hypochondriac region, referred to the back. Vomiting occurred on an average of once a week and gave relief from subjective symptoms. Hearburn set in usually fifteen to thirty minutes after a meal.

During the earlier part of the stay in the hospital the asthma was not severe, in fact almost unnoticeable. The patient was given a Sippy diet in an attempt to control subjective gastric symptoms.

The curve before instituting the diet showed a rising and sustained curve, slight hyperacidity, motility normal. During the

first ten days of restricted diet the patient reported progressive improvement; on the tenth day the patient became excited over the administration of a dose of Epsom salts for constipation. He felt convinced that the cathartic had harmed him and injured his treatment. During his excitement a severe attack of asthma set in. A fractional test which had been ordered for the same morning showed a marked hypersecretion of the most typical continuous type (magensaftfluss). Specimens were obtained up to four and three-quarter hours after the ingestion of the meal and the profuse limpid fluid flowed freely.

This incident is cited to indicate the role that powerful psychic irritation plays in the control of secretory regulation in the body. Pawlow and Cannon have emphasized the influence of fear, anger and other excited emotions on the gastric secretions. In the experimental studies on animals inhibition of secretion was more common. In this clinical case there is evidently a direct central nervous system stimulation with apparent radiation down the stimulatory fibers of the vagus, including probably both the asthma and the gastric hypersecretion (parasympathetic path).

It is comprehensible that most of the cases in the group of "nervoses" bear an analogy to this the above incident. For in them there is a constant nervous overexcitation. Bad news from home or an irritating incident serves only to exaggerate the type of the case.

Organic nervous disease may and does cause the same symptoms. Tabes has long been recognized as an etiologic factor in periodic gastrosuccorhea (von Leyden). Tumor of the brain may do the same as well as hysteria. This is the group classed by Reichmann and accepted by successive writers as "periodic continuous hypersecretion," that is hypersecretion present during the attacks or crises of the nervous malady and absent in the remission periods. The clinical picture termed by Rossbach "gastroxynsis," is only another subspecies of this same group; it consisted of attacks of vomiting of copious amounts of fluid associated with headache and crises of nervous or hysteric character.

The curves obtained in the cases of migraine were remarkable not only for the presence of hypersecretion but because of the very prolonged emptying time of the organ. There is evidently a powerful nervous stimulus irradiated along both motor and secretory nerves of the organ, inducing motor pylorospasm and secretory hyperstimulation. As a clinical picture pylorospasm as a result of organic disease of the central nervous system is well recognized as an accompaniment of tabes, brain abscess or brain tumor. The stimuli reaching the stomach in the above-cited cases of migraine are apparently of analogous, though not identical origin. We have established hypersecretion as occurring then, in three groups of cases:

1. Organic disease of the stomach, particularly ulcer (intrinsic origin).

2. Organic disease of associated abdominal organs (reflex action).

3. Hyperirritable conditions of the cerebral or autonomic nervous system, both organic or psychic (extrinsic origin).

Does hypersecretion ever occur in normal individuals? Rehfuß²² has expressed the opinion that hypersecretion does occur occasionally in individuals in a state of perfectly normal health, and cites an instance in a group of students studied as normal controls. He reiterated this opinion quite recently in a paper²³ read before the American Gastro-enterological Society last year. Yet the large number of control cases cited by him in his series, as well as those of Fowler and Zentmire,²⁴ and our own controls, numbering many hundreds in hospital cases observed for all varieties of ailments, denies the point that hypersecretion is a normal phenomenon or occurs more than as a great exception in persons entirely devoid of organic or psychic stigmata. It is just as likely that the occasional so-called normal individual upon whom a control test is made is really a potential psychoneurotic or vagotonic. It may be argued that all of our studies have been on chronic hospital cases or cases actively complaining of well-defined symptoms. Still we answer that in the hundreds of cases observed with a functionally normal digestive organ the stomach empties itself promptly at two hours, and thereafter no further secretion is obtainable. All cases varying from this standard by showing digestive or post-digestive hypersecretion are regarded as suffering with a functional aberration from the normal secretory standard of health.

In the light of the studies made upon this series of 50 cases, closely observed and studied, let us review critically the clinical literature of the last twenty-five or thirty years on the subject of hypersecretion. Does Reichmann's disease exist today as an independent clinical entity? This is best answered in the negative. Practically all the cases described by Reichmann² and Riegel,^{4,9} Strauss,¹¹ and others were typical instances of ulcer complicated by continuous hypersecretion. Soupault operated upon 58 cases of so-called Reichmann's disease and found ulcer in all of them.

But continuous hypersecretion as a symptom does exist, not as an independent disease but as one symptom, usually a secondary symptom, of other diseases, organic or neurogenic.

All the clinical symptoms of Reichmann's disease, such as pains, vomiting, pyrosis, loss of weight and continuous hypersecretion may be seen associated with various clinical conditions other than peptic ulcer.

The group of periodic hypersecretion stands today in an unmodified and strong position, as originally described by von Leyden,²⁵ Rossbach,⁶ Moebius²⁶ and others. The hypersecretion is not the

disease but is the secondary phenomenon of a malady of the cerebral nervous system.

What can we say of digestive or alimentary hypersecretion, as revived by Strauss,¹¹ and discussed by Calvo and Zweig,²⁷ etc? Many of these writers attempted to associate all hypersecretion with ulcer. We see from the data in this series of cases that they claimed too much and that barely a rough 33 per cent. can be so classified.

It may not be amiss to discuss the nervous mechanism by which an abnormal secretory activity of the gastric acini is produced. The stimulatory fibers to the glands of the stomach are regarded as being in the parasympathetic system or the pneumogastric nerve; inhibition of secretion rests with the sympathetic system whose neurons lie in the celiac plexus. The extrinsic motor control follows in general the same routes. Abnormal stimuli originating in other nervous ganglia of the abdominal plexuses are referred or reflected along the vagus system, producing exaggerated peristalsis, pyloric irritability and pylorospasm and supersecretion. This is termed by Head and Pottenger²⁹ a viscerosensory reflex. The close association between vagotonia (Eppinger and Hess³⁰) and most of these cases of hypersecretion is worthy of attention. The relation of vagotonia to ulcer of the stomach and duodenum has been repeatedly pointed out (Petrin and Thorling³¹); one cannot overlook the possible sequence of vagotonia, hypersecretion and ulcer. Hypersecretion of long standing may conceivably induce ulceration, or, *vice versa*, the presence of an ulcer may cause, by intrinsic irritation, a sequential supersecretion.

The efforts of Nikolayzen³² to produce hypersecretion by pilocarpin stimulation of the vagus nerve were unsuccessful; his experiments are too few to warrant sincerely doubting the above-mentioned hypothesis.

There is reason to believe that adrenal insufficiency plays a role in this symptom, either through the thyroid gland or independently of it. The experiments of Fiuri,³³ of Friedman³⁴ and of Mann³⁵ in the production of ulcers by adrenalectomy and pilocarpin injections are very suggestive along this line.

The question has often been raised by previous writers whether delayed motility was not accountable for the large amounts of fasting contents and test-meals removed in this class of cases. J. Kaufmann³⁶ has demonstrated in a typical case of Reichmann's disease that the predominant factor was a delay in motility due to ulcer. There is no question that in the cases of gastrosuccorhea of organic gastric origin, delayed motility plays an important and mechanical role. But in the remaining cases of this group, periodic and alimentary hypersecretion, no delay in the exit of food was demonstrable. Atony as a factor deserves today but little consideration, since normal emptying time is not inconsistent with a

well-marked atony. It is the opinion of the authors that delayed motility is not an essential or intrinsic factor in hypersecretion. It often accompanies gastrosuccorhea, but just as often, or more so, we note normal emptying time with exaggerated supersecretion.

The cases of migraine with markedly delayed motility are exceptions, but deserve very close notice because of the unusual and extensive degree of the motor insufficiency.

Treatment. The indications for the treatment of gastric hypersecretion are clearly laid down in the general principles of this paper. The importance of removing both extrinsic and intrinsic stimuli of an abnormal nature is self-evident. Restriction of diet is one of the basic principles; rest in bed is a necessary corollary of this treatment. In a series of cases of hypersecretion studied by the author and previously reported the effect of marked restriction of diet, both solid and fluid, was studied; 45 per cent. showed local improvement in the chemism of the stomach and 80 per cent. were discharged from the hospital free of symptoms. The use of atropin is warranted by experiments published recently.³⁷ We were able to demonstrate a striking reduction in the supersecreted fluid after hypodermic administration of this alkaloid. Less favorable results followed the administration by the mouth or over even longer periods.

The removal of abnormal nerve stimuli, whether of cerebral nerve system or of viscerosensory origin, is self-evident; no treatment that ignores the psychical condition of the patient will be effectual in a case wherein vagotonia is a factor or hysteria or a psychoneurosis is present.

Organic brain or spinal-cord disease once diagnosed, calls for its own treatment.

Summary. 1. Hypersecretion is a symptom; it is a functional disturbance of the secretory apparatus of the stomach. It is not a disease *per se*.

2. It is a frequent symptom, occurring most commonly in males, and being present in probably at least 10 to 15 per cent. of all persons with gastric complaints.

3. Its occurrence is independent of the acidity titer of the stomach; it is found more often associated with hyperacidity, but can be seen through all the grades of acidity, even in achylia gastrica.

4. Most of the cases of hypersecretion are of the continuous type, lasting throughout the digestive and interdigestive period. The most severe type of cases, when associated with vomiting, emaciation, thirst, epigastric pain, etc., constitute Reichmann's disease. These cases are nearly all due to gastric or duodenal ulcer (intrinsic cause).

5. Of the milder grades of continuous hypersecretion (alimentary hypersecretion, without vomiting, etc.), many of the cases are attributable to ulcer (about one-third); the remainder are due to abnormal nerve irritation, either *reflexly* from abdominal disease in other organs or from neurotic instability, such as vagotonia, psychoneurosis, etc. (extrinsic cause).

6. A few cases are due to diseases of the cerebral nervous system, hysteria, psychic causes, etc. (intermittent hypersecretion).

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OBSERVATIONS UPON THE TREATMENT OF THE CHRONIC INTESTINAL INVALID.*

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I. INTRODUCTION. The object of the present paper is to record some of the more definite impressions which have resulted from a ten-year intensive study of the chronic intestinal invalid. In 1910, when this study was first undertaken, information of value in regard

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